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HIGH-SPEED BORING IN USSR REPLACES GRINDING, SAVES ABRASIVE WHEELS

L. N. Skandov

The steam and air cylinders of a pump are similar to each other in technology and design. The basic difficulty of their manufacture lies in the machining of two diameters, $190A_3$ and $290A_3$, for a length of 410 millimeters. The distance between centers is 302 millimeters, which must be maintained to an accuracy of ±0.1 millimeter.

The requirements for surface finish and linearity are very high. Rejects of cylinders due to finish or size flaws constitutes a large expenditure because machining the part is laborious and the cost of the billet is high. The billet is a large, complex gray-iron casting, Brinell hardness (H_B) = 180÷220, weighing 151 kilograms.

The process, until 1948, was as follows:

1. The preliminary and subsequent boring of holes to diameters of 190 and 290 millimeters was done on a vertical boring and turning lathe with a single-cutter boring bar. The time norm for boring both cylinders was 70 minutes.

2. The finish boring of cylinders on the Plant imeni Sverdlov R-80 boring machine was also done with a single-cutter boring bar. The time norm was 90 minutes.

3. The subsequent grinding of both cylinders was done on an internal grinder with planetary movement of the spindle; the spindle was equipped with carborundum-extra (CM_{46}-CM_{60}) disks.

Thus, by the old technological process, 313 minutes were consumed for machining one part.

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In an effort to lower costs of machining, decrease rejects, and save scarce grinding wheels, a plant has developed a method for simultaneous high-speed boring of both cylinders, completely eliminating the need for grinding operations. This method required special equipment, which was manufactured by a machine-tool plant.

Designed on the principle of the type 262-G boring machine, the LR-6 special machine tool (Figure 1) has a standard headstock (1), a table (8) with longitudinal and traverse feed. The fixture (7) is mounted on the table. The part (5) is secured to the fixture (7) by means of clamps (4) and (6). Clamp (4) presses the part to the fixture by means of a thrust collar and clamp (6) by a bearing flange.

Between the table (8) and headstock (1) there is a special head (2) with two working spindles which are mounted on precision roller bearings. In order to maintain an even cutting speed on both cylinders, the spindles are connected to each other by a gear drive with a gear ratio of 1.35. The spindles of the headstock (2) carry special tool heads (3).

The cutting head (Figure 2) consists of a main body with a guiding part (G) and a tapered shank, which is eccentric with guide (G). The rotating part of the head on guide (G) can be turned and secured in the required position by means of an index pin (5), which enters into slots in the shank (see cross section CC), after which it is secured with a bolt (4). The head has four cutters two according to cross section AA and two according to cross section BB. The cutters (2) are inserted in the head, set to size for machining the cylinders by screws (6) and are secured by screws (7). The eccentric setting of the head (3) on the shank (1) makes it possible to adjust the cutters for the position required for machining the surface and to shift them after they have completed their operation. The index pin (5) automatically insures the necessary size of the bore. Excellent results were obtained when this head was put into operation.

According to the new technology, the procedure for boring the cylinders is as follows: the part, which has been installed on the machine-tool fixture, undergoes preliminary boring with two passes of two roughing cutters. The first one of these cutters removes the cast surface to a depth of 2.5 millimeters.

After removal of this surface, the first roughing cutter is set with an eccentricity of e = 10 millimeters in a nonoperational position (a smaller radius), and is replaced by the second roughing cutter which, after its pass, also withdraws into a smaller radius, and in its place a finishing cutter emerges which finishes the cylinder bore.

Standard working conditions are given below:

Operating Conditions	190-mm Diameter Hole		290-mm Diameter Hole	
	Roughing	Finishing	Roughing	Finishing
Speed of cutting, meters per minute	57	114	64	128
Depth of cut, mm	1.5	0.5	1.5	0.5
Feed, mm/rev	0.39	0.07	0.52	0.095
Number of passes	2	1	2	1

After the finishing pass, the finishing cutter, like the roughing cutter, withdraws into a nonoperating position and another cutter takes its place for removing the chamfer edges from both sides of the cylinder. The total length of time for machining the part by the new process is 200 minutes, of which 70 minutes are used for rough boring and 130 minutes for finish boring.

Machining time was cut 36 percent and cost 45 percent. In addition, expenditure of scarce ~~grinding~~ disks for this operation was eliminated, two machine tools were freed, and one grinding machine operator was released. Overhead costs were decreased throughout the shop.

/Appended figures follow./

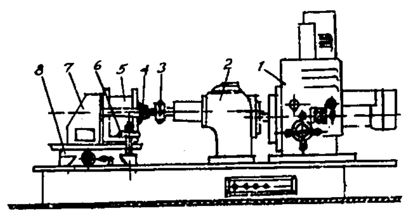

Figure 1

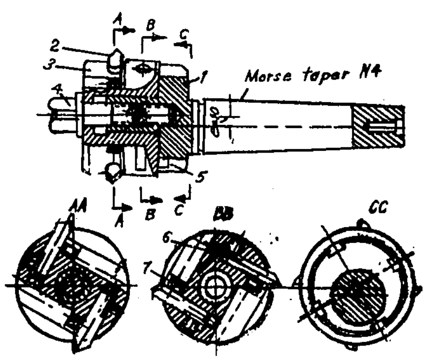

Figure 2

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